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Pesticides, Caution, and Experimentation in St. Vincent, Eastern Caribbean

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Understanding the problem of pesticide misuse in the Third World requires analysis of both political–economic forces and local-level variations in peasant behavior and attitudes. This study, based on 12 months of fieldwork during 1988–1989, examines growing agrochemical dependence and misuse in St. Vincent and the Grenadines in the East Caribbean. Consistent with findings from other political–economic studies, this research documents the influence of the state, export agriculture, consumer pressure, and foreign aid in leading to increased chemical use in agriculture. This study also considers the extent to which farmer behavior and attitudes limit or exacerbate the problems that can accompany increased pesticide use. Some researchers emphasize that farmers are careless and indiscriminate when using pesticides, thereby contributing to pesticide-related problems. In contrast, data from the village level reveal that although some farmers are careless, others are cautious in their use of pesticides, a pattern reflective of variability among farmers in pesticide-use practices and attitudes in general. By exploring the issue of variability in patterns of pesticide use among villagers, this paper emphasizes the utility of the concepts of individuality and experimentation in agriculture in examining problems of pesticide misuse.

KEY WORDS: pesticides; export agriculture; St. Vincent and the Grenadines; Caribbean.

INTRODUCTION

A small but growing literature focuses on patterns and problems of pesticide use in the Third World (Weir and Schapiro, 1981; Bull, 1982; Goldberg, 1985; Thaman, 1985; Wright, 1986, 1990; Tait and Napompeth,

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1987; Thrupp, 1988, 1990a,b). A prominent theme in this literature is the powerful influence that political–economic forces have on patterns of pesticide use. Marketing policies of unscrupulous, profit-seeking multinational corporations that manufacture pesticides (Weir and Schapiro, 1981), lack of effective regulatory policies in the Third World (Bottrell, 1984; Goldberg, 1985), class relations in agriculture (Wright, 1986), constraints imposed by poverty (Bull, 1982), and the changing requirements of commercial agriculture for both external and internal markets (Goldberg, 1985; Goldman, 1986) all contribute to growing dependency on and misuse of pesticides.

The focus on political–economic forces has certainly enhanced our understanding of agrochemical use in the Third World. Such a perspective is essential for uncovering the pressures leading to increased pesticide dependence and misuse. However, these analyses are generally weak at the local level. They ignore the manner in which farmers' attitudes, perceptions, and strategies limit or exacerbate the pesticide misuse that can accompany growing agrochemical dependence (Goldman 1986).

A key issue relevant to understanding behavior that can limit or exacerbate problems associated with pesticide dependence is whether farmers use these chemicals carelessly and indiscriminately. The political–economic literature does not emphasize such behavioral issues, instead focusing on broader-scale, structural forces. However, other studies of pesticide use that are either local-level surveys or reviews of surveys do address the issue; these local-level studies reflect a variety of perspectives, ranging from descriptive summaries to interests in decision-making and risk perception. Several of these studies emphasize that farmers are indeed careless and indiscriminate in the use of pesticides. For example, Medina (1987, p. 157) asserts:

> There is much overuse, misuse and abuse of pesticides by vegetable farmers in the Philippine Cordillera. Spraying pesticides has now become a habit, rather than a necessity, and spraying is done indiscriminately.

Similarly, Mohan (1987, p. 77), in an overview of local-level problems in Malaysia, reports that "It is regrettable that the situation has been allowed to deteriorate to the point where Malaysian farmers are suffering severe crop losses and also endangering their health and safety by the excessive use of pesticides." Other researchers have used the terms "careless" and/or "indiscriminate" in characterizing pesticide use in Third World rural communities (e.g., Zaidi, 1984; Thaman, 1985; Black et al., 1987; Guan-Soon and Seng-Hock, 1987).

Certainly, indiscriminate and careless use of pesticides exists, and it aggravates problems associated with increasing agrochemical dependency.

The desire of researchers to emphasize misuse is understandable given the potential negative impacts on human health and the environment and the drastic need for regulatory reform and enforcement in relation to pesticides in the Third World. However, researchers who emphasize only pesticide misuse create the impression that carelessness and indiscriminate use are characteristic of the rural communities they examine. Indeed, most researchers rarely emphasize or even consider the extent to which farmers are cautious in relation to pesticide use, though work by Goldman (1986) is a notable exception.

Although researchers have not adequately examined the extent to which some farmers are careless and indiscriminate while others in the same community are cautious, they have explored variability in other aspects of agrochemical use. They have documented considerable diversity among farmers in relation to whether they use pesticides, which ones they select for particular purposes, the amounts they apply, and the methods of application employed (Fagoonee, 1984; Heong, 1984; Zaidi, 1984; Goldman, 1986; Waibel, 1987). To explain these differences, researchers have examined the influence of socioeconomic variables such as age, income, farm size, and education on patterns of pesticide use.

Given such documented variability, it is necessary to also explore the existence of both caution and carelessness in the same community. Moreover, while socioeconomic differences account for some variations in pesticide use, another dimension must be considered. In particular, differences among farmers in agrochemical use should also be viewed as resulting from two characteristics of all farming communities—"individuality" and "experimentation." Johnson (1972) employed these concepts to illuminate sources of innovation and change in traditional agriculture, but his analysis is also very relevant to understanding variations in contemporary pesticide use.

Johnson asserted that the longstanding stereotype of uniformity in traditional agricultural practices was inaccurate. In contrast, he declared, considerable diversity is evident in farming practices among community members, reflecting the pattern generated by "individuality" and "experimentation." "Individuality" is the tendency for villagers to make agricultural decisions based on their own individual preferences, experiences, needs, and perceptions, all of which vary from farmer to farmer. "Experimentation" is the tendency for farmers to experiment regularly with new cultivation techniques and crops with the goal of improving their production potential. I assert that individuality and experimentation are also evident in pesticide use; they contribute not only to problems of misuse but also help account for the existence of varying degrees of caution and carelessness in pesticide use in the same community.

This case study focuses on pesticide use among peasants in a village in St. Vincent and the Grenadines in the Eastern Caribbean. It first outlines the political–economic forces that have contributed to the growth of agrochemical use in the country. The examination then shifts to the village level, where problems of pesticide misuse are revealed. This study does not gloss over the issue by simply arguing that farmers are carelessly and indiscriminately applying agrochemicals. Rather, the dimensions of both caution and carelessness are explored. I then consider how variability in attitudes and practices associated with pesticide use is related to "individuality" and "experimentation."

PESTICIDES IN ST. VINCENT

St. Vincent and the Grenadines, located 100 miles to the west of Barbados in the Eastern Caribbean, is composed of a series of small islands. The largest and economically most important is St. Vincent, a rugged volcanic island 18 miles long and 11 miles wide. Approximately one-fourth of the island's 105,000 people live in urban areas, with the largest concentration in the port capital of Kingstown.

St. Vincent and the Grenadines is a former British colony whose primary economic activity has always been agriculture. Bananas, destined mostly for the British market, are the leading export cash crop. They currently cover approximately one-third of the land in agriculture. The industry is regulated by the St. Vincent Banana Growers' Association (SVBGA), a statutory corporation that provides farmers with credit and extension services, imports and sells them a variety of agrochemical inputs, and purchases their bananas destined for the export market. The SVBGA, in turn, sells all bananas for export to Geest Industries, Ltd., a large British multinational, which ships them overseas and then ripens and distributes them in the United Kingdom. The large majority of banana growers in St. Vincent are peasants cultivating less than 2 ha (5 acres) of bananas. In addition to bananas, peasants grow a variety of other crops for subsistence and sale in local and regional markets, including plantains, tree fruits, several root and tuber crops, and garden vegetables such as tomatoes, cabbage, beans, and carrots.

The amount of pesticides applied to these crops has increased dramatically over time. In 1955, when the banana industry was in its infancy and pesticide use was minimal, St. Vincent and the Grenadines imported only EC$ 21,041[2] worth of pesticides (St. Vincent and the Grenadines,

[2]Since 1976, US$1.00 = EC$2.70. Before then, the Eastern Caribbean dollar was tied to the

1956). By 1989, that amount had grown dramatically to EC$ 5,432,044 (St. Vincent Office of Statistics files).

St. Vincent and the Grenadines is more restrictive than many other Third World countries in controlling the importation of pesticides (see Weir and Schapiro, 1981). The Pesticide Control Board, the government agency responsible for controlling pesticide importation, sale, and use, prohibits the importation of several pesticides, including DDT, aldrin, dieldrin, heptachlor, DBCP, Toxaphene, aldicarb, and parathion. These pesticides can be found in many other Third World countries, even though they are banned or highly restricted for use in the United States (Bull, 1982; Zaidi, 1984; Goldman, 1986). Of all the pesticides widely used in St. Vincent, only one, Gramoxone (paraquat), is on the Pesticide Action Network's "Dirty Dozen" list.[3] However, the nematicides employed in the banana industry—Mocap (ethoprop), Furadan (carbofuran), and Vydate (oxamyl)—are also highly toxic and restricted for use in the United States.

The banana industry is clearly the largest consumer of agrochemicals in St. Vincent. In 1988, the SVBGA imported over 90% of all bulk pesticides brought in to the island nation (SVBGA files; Office of Statistics files). The SVBGA sells pesticides to farmers from its large bulk warehouse located in Kingstown.[4] Information concerning which pesticides to use is based on recommendations from the Windward Islands Banana Growers' Association (WINBAN), the regional organization representing the four banana growers' associations in the Windward Islands. WINBAN conducts research trials on its experimental farm in St. Lucia and provides advice based on the results.

Export crops, of which bananas are clearly the most important, are not the only ones receiving doses of pesticides. Farmers also attempt to control pests using agrochemicals on a variety of other crops, such as cabbage, tomatoes, and carrots, which are destined for home consumption, the local market in Kingstown, or regional markets. Peasants purchase some pesticides for these food crops at the few retail outlets in Kingstown selling agrochemicals and use others obtained from the SVBGA.

British pound at £1 = EC$4.80. The large majority of pesticides imported are used in agriculture.

[3]The Pesticide Action Network established the "Dirty Dozen" list in 1985 to encourage stricter regulation of particularly hazardous pesticides that are sold worldwide but are banned, unregistered, or severely restricted for use in many industrialized countries. The Dirty Dozen list currently includes 18 pesticides, of which nine are still used in the United States. Of all the pesticides on the list, paraquat (Gramoxone) is the least regulated worldwide.

[4]The SVBGA warehouse is the main source of agrochemical inputs in St. Vincent. Unlike in some other Third World countries, pesticide company salesperson involvement with peasants is very minimal.

POLITICAL-ECONOMIC CONTEXT OF INCREASING PESTICIDE USE

As is true in other parts of the Third World (e.g., Bull, 1982; Goldman, 1986), increasing reliance on pesticides in St. Vincent is closely related to the changing requirements of commercial agriculture.[5] Developments in the banana industry have been the major force leading to greater dependence on agrochemicals, though more pesticide use over time is also evident on crops produced for sale in the Kingstown market. Application of the majority of pesticides in St. Vincent on crops exported to the industrialized world is a characteristic pattern in the Third World (Goldberg, 1985). Understanding growth in pesticide use in banana cultivation requires analysis of changing patterns of government intervention in the industry and British marketplace demands.

St. Vincent and the Grenadines and the other Windward Islands (St. Lucia, Dominica, and Grenada) are former British colonies whose economies have historically centered on export agriculture. After World War II, the British government encouraged the development of the Windwards export banana industry for several reasons: to help alleviate its own balance of payments problems, it wanted to facilitate more food imports from Commonwealth sources; it hoped to diversify agriculture in the islands away from dependence on traditional export crops; and it viewed bananas as a crop that could be grown profitability under peasant farming conditions and improve peasant welfare.

The British government fostered the growth of the banana industry in the 1950s by creating a protected market for the Windwards and other Commonwealth banana producers (such as Jamaica). It established tariffs and quotas primarily to limit the amount of bananas that could be imported from Latin American countries, the dominant source of exported bananas in the world economy. Such market protection was necessary because Latin American growers, benefitting from economies of scale on their large enterprises and the low wages paid their workers, could produce bananas at lower cost and higher quality than Windwards farmers.

The protected market in the United Kingdom enabled bananas to become the leading export crop by the mid-1950s not only in St. Vincent but also in two other Windward Islands, St. Lucia and Dominica. During the industry's first few years, relatively high prices for bananas in the protected United Kingdom market spurred rapid growth in production. The

[5]As other studies indicate (e.g., Thaman, 1985; Perritt, 1988), pesticide use in subsistence agriculture in some cases can also be significant.

Windwards, along with Jamaica, became the major suppliers of the British market by 1959.

However, during much of the 1960s and 1970s, profitability for banana farmers in St. Vincent and elsewhere in the Windwards declined considerably. By the late 1960s, a sense of crisis pervaded the industry. Because of poor financial returns, compounded by periodic drought, windstorms, and pest infestations, banana exports from the Windwards stagnated and began to decrease in the 1970s. Consequently, the Windwards (as well as the other Commonwealth producers) were not able to supply enough bananas to the United Kingdom to fill the market share protected for them. To fill the void, the British government on many occasions was forced to allow Latin American producers to export more bananas to the United Kingdom than would otherwise have been permitted under the established quotas. Officials in WINBAN and in the four banana growers' associations feared that if the Windwards continued their pattern of low banana production, the British government might increase permanently the amount of bananas that could be imported from Latin America. The possibility of losing their market protection created a sense of dread in the Windwards because the islands had become so dependent economically on banana exports.

Although a variety of fundamental constraints contributed to low incomes and declining production, officials in the Windwards banana industry and their economic advisors in the British Development Division in the Caribbean (BDDC)[6] focused on solving two problems to save the industry: low productivity per unit area and poor banana quality. A key component in their strategy to overcome these problems was to ensure peasants intensified their use of pesticides. Pest infestations, which were increasing over time, contributed to both low productivity per unit area and low fruit quality. Bananas grown for export are susceptible to a variety of pest problems, given planting densities of 1600-1700 plants per hectare (650-700 per acre). Two major pests that farmers must control are nematodes (*Radopholus similis*, *Rotylenchulus reniformis*, and *Helicotylenchus* spp.) and the banana borer (*Cosmopolites sordidus*).[7] Nematodes are microscopic organisms in the soil that attack and weaken the root systems of plants, making them more susceptible to toppling and interfering with nutrient uptake. Borers attack the roots and corm. Infestations of both pests can cause substantial declines in yields and inhibit the growth of high quality fruit.

[6]The British Development Division in the Caribbean is the British agency responsible for designing and administering British foreign aid programs for the region.

[7]Another major pest problem plaguing the banana industry is banana leafspot, which is controlled by the SVBGA through aerial spraying and ground crews. The major type of banana leaf spot in the Windwards is Sigatoka disease, caused by the fungus *Mycosphaerella musicola*.

In the early stages of the industry in the 1950s, losses due to pests were minimal, but as farmers continued to replant bananas in the same fields, pest attacks multiplied. The pattern of cultivation also encouraged pest problems. Although many small-scale farmers intercropped bananas with a variety of food crops, they harvested most food crops within nine months after planting. For the rest of the time that the banana crop remained in the field—usually for another 1-2 years—the sea of banana plants created a mostly monocultural stand (a few scattered tree crops also remained), which also facilitated pest infestations.

These pest problems, coupled with farmers using less fertilizer than officials recommended, contributed to the low yields. Consequently, banana officials in the Windwards and their advisors in the BDDC decided it was necessary for peasants to apply more agrochemicals—both pesticides and fertilizers—to boost productivity per unit area. The potential for improved yields suggested by increasing chemical use in banana cultivation was considerable. Officials in the industry viewed with envy the impressive banana yields (up to 50 tons per hectare [20 tons per acre]) achieved in the nearby French-speaking islands of Martinique and Guadeloupe, where farmers were applying much higher levels of chemical inputs than the Windwards growers. In contrast, in the 1960s and 1970s, Windwards farmers obtained relatively poor yields (7-12 tons per hectare [3-5 tons per acre]).

The problem of low fruit quality was also depressing farmers' incomes. Fruit quality is a key determinant of marketability and hence the price farmers receive from the sale of their banana crop. High quality fruit has a variety of characteristics, including being fully formed and well-shaped, characteristics dependent on adequate nutrient intake and proper growth rates. Because pests in St. Vincent and elsewhere in the Windwards were interfering with these processes, they were a constraint on improving fruit quality and hence profitability. Both Geest Industries and the British government were continually complaining about the low quality of bananas being shipped from the Windwards. The pressure to improve quality intensified over time as the British banana market became increasingly selective in relation to the quality of bananas it demanded.

To encourage small-scale farmers to use more agrochemicals in the attempt to improve both productivity per unit area and fruit quality, the British government, through the BDDC, supplied the SVBGA and the other three Windward Islands banana growers' associations with free and subsidized pesticides and fertilizers on numerous occasions.[8] Its foreign aid programs also supported several banana replanting and rehabilitation

[8]Most efforts to improve fruit quality focused on innovations in harvesting and packaging, but increased pesticide use was also a significant component in the drive.

schemes from the late 1960s to the early 1980s. These schemes provided subsidies for chemical inputs and financial support for more intensive banana agricultural extension efforts, thereby leading to greater use of both pesticides and fertilizers. As a result, Vincentian farmers have been able to raise yields to approximately 17 tons per hectare (7 tons per acre) by the late 1980s (St. Vincent Banana Growers' Association, 1990).

Financial policies of the SVBGA have also been oriented toward encouraging increased pesticide use. One longstanding policy has been to grant farmers purchasing inputs interest-free credit with liberal repayment schedules. A second policy, established in 1974, forces farmers to save a portion of the proceeds from their banana sales for future purchases of agrochemicals.

Continual exposure to messages about the importance of pesticides has also influenced banana farmers. Extension agents of the SVBGA urge villagers to use pesticides to control nematodes and borers on a set schedule, a message reiterated on the SVBGA weekly radio program, "Banana Corner," heard each Saturday night. Catchy radio advertisements sponsored by pesticide manufacturers reinforce the message that regular use of pesticides in banana production is necessary.

While these changes were taking place in the banana export industry, food production for sale in local and regional (intra-Caribbean) markets also became increasingly dependent on pesticides, though to a much lesser extent than the banana industry. Government pressure on farmers to use pesticides on food crops is minimal compared to that in banana production, in part because pest problems are less severe on food crops and also because historically government support for agriculture in St. Vincent and elsewhere in the Windwards has usually focused on export crops. Farmers' contacts with government agricultural extension officers, who provide advice on pesticide use on food crops, is less frequent than it is with SVBGA agents. Also, government involvement in regulating the sale of local food crops is marginal. Nor are advertisements for pesticides specifically imported for use on food crops very prominent.

Nevertheless, growth in chemical use in banana production has influenced trends in local food crop cultivation. Although British aid programs and SVBGA credit schemes have been aimed specifically at banana cultivation, they have also stimulated increasing agrochemical use in food crop production; many farmers use herbicides and insecticides obtained from the SVBGA in their fields with local food crops.

Chemical dependence in local food cultivation also parallels that in the banana industry in its reflection of the changing requirements of commercial agriculture. Similar to the problem faced by banana growers in their overseas market, Vincentian farmers producing for sale in their home mar-

ket are finding their urban Kingstown customers increasingly selective concerning the quality of produce they are willing to purchase. Undoubtedly, consumer exposure to the image of perfect, blemish-free produce through television and overseas migration has influenced the trend toward increasing selectivity. Blemishes that were once ignored by customers ten or twenty years ago would make produce unsaleable today. Farmers realize that tomatoes marked with black spots caused by flying insects they call "booboo" (*Hemiptera pentatomidae*) or cabbages riddled with numerous small cavities caused by the diamondback moth (*Plutella xylostella*) and the budworm (*Helulla phidilealis*) will not be marketable. Consequently, Vincentians strive to produce blemish-free crops by using more pesticides.

Moreover, villagers assert that pest problems in food crops today are worse than they were in the past, a condition that may be related either to pests developing resistance to pesticides, to agrochemicals destroying the predators of pests, or to the marked reductions in fallow periods caused by the expansion of banana cultivation. Consequently, farmers are findings that they have had to increase their use of pesticides. The greater difficulty in controlling pests today through chemical means is clearly reflected in the remarks of one experienced female farmer who, in discussing pests' increasing ability to withstand chemical control, declared, "Worms [pests] know all the tricks now."

PATTERNS OF PESTICIDE USE AT THE VILLAGE LEVEL

The processes described concerning pressures for increased pesticide use have been felt clearly in the Marriaqua Valley, a fertile agricultural area in the southeast part of St. Vincent. Bananas today dominate the landscape in the valley, though a variety of local food crops produced for home consumption and sale in local markets can also be found. Pesticide use there has increased considerably since the 1950s and is now an integral part of the agricultural system.

I conducted research in the valley in one village, Restin Hill (a pseudonym), from August 1988–1989, focusing on patterns of agricultural change (see Grossman, in press, a). Restin Hill's population of 333 is divided among 64 households, the majority (55%) headed by men. All farmers operate small-scale enterprises; the largest landholding in the village is 6.3 ha (15.6 acres), but the majority of farming households, 85%, control 2 ha (5 acres) or less. Not all households are involved in farming; 19% of the 64 households are not farm operators, depending instead mainly on wage labor (mostly in agriculture and trades) for their livelihood.

Table I. Distribution of Number of Pesticides Reported Used, by Household, Restin Hill Sample, Previous 12 Months (July–August 1988 to July–August 1989)[a]

Number of pesticides reported used	Number (%) of households
0	1 (3)
1	0 (0)
2	3 (8)
3	10 (27)
4	11 (30)
5	6 (16)
6	4 (11)
7	1 (3)
8	1 (3)

[a] $n = 37$.

Bananas cover 77% of the cultivated land, either in "pure stands"[9] or intercropped with local food crops, such as "ground provisions" (root and tuber crops, especially dasheen and eddoes [*Colocasia* spp.] and tannia [*Xanthosoma* spp.]) and garden vegetables such as cabbage and tomatoes. In contrast, local food crops cover only 29% of the land, either intercropped with bananas or planted separately. People grow some local food crops for household consumption but sell the majority either in the Kingstown market or to traffickers who market food crops, primarily ground provisions, in nearby islands. In many cases, people eat the crops that they could not sell.

As part of my research on agricultural change, I examined practices and attitudes concerning pesticides using three different methods. One was direct observation of agricultural activities during the 12-month period. Another was informal discussions on the topic with farmers. The third was formal interviews conducted at the end of the research period in July–August 1989 with farmers from 37 of the 52 households engaged in agricultural production.[10] My original goal was to complete interviews with one member from each of the farming households, but time constraints prevented me from doing so. Nevertheless, the study includes a sample of sufficient size to be representative of the variability among pesticide users in the village. Members from both male-headed and female-headed households participated in the survey, with 62% of the respondents being from male-headed households. Those participating in the interview, who were adults ranging in age from 23 to 72 years, were familiar with the pesticide-use patterns

[9] The term "pure stands" here refers to the absence of ground provisions and garden vegetables. In any banana field, there are usually a few coconut or fruit trees.

[10] A household had to cultivate at least .04 ha (0.1 acres) to be considered as being involved in agriculture.

Table II. Number (%) of Households in Restin Hill Sample Reported Using Various Pesticides, Previous 12 Months (July–August 1988 to July–August 1989)[a]

Pesticide brand name	Common name	Number (%) of households
Gramoxone	Paraquat	35 (95)
Primicid	Pirimiphos ethyl	33 (89)
Mocap	Ethoprop	19 (51)
Sevin	Carbaryl	19 (51)
Furadan	Carbofuran	14 (38)
Basudin	Diazinon	13 (35)
Other[b]	—	9 (24)
Decis	Deltamethrin	3 (8)
Malathion	Malathion	3 (8)

[a] $n = 37$.
[b] "Other" includes cases in which farmers did not know the names of the chemicals and cases in which they used spray cans containing insecticides intended for residential use on their food crops.

of other members of their households. Landholdings of the households ranged from .04 to 6.3 ha (0.1–15.6 acres). I conducted all the interviews.

Data from the formal interview reveal the extent to which pesticide use has become an integral part of Vincentian agriculture. Ninety-seven percent of the households had used at least one synthetic pesticide in the previous 12 months, with the average being four (see Table I). Such widespread adoption of pesticides is characteristic in most Vincentian farming communities. Collymore (1984, p. 215), interviewing a sample of farmers in the northeast and northwest parts of the island in the early 1980s, found 94% of the surveyed farmers there used pesticides.

The most widely used pesticide in Restin Hill (and elsewhere in St. Vincent) is the herbicide Gramoxone (paraquat) (Table II), which farmers apply in banana fields and, to a lesser extent, in the cultivation of food crops. Gramoxone use is widespread because applying it is less time-consuming than traditional hand weeding, a major advantage in an agricultural system in which labor shortages are a major constraint. The next most widely used pesticide is Primicid (pirimiphos ethyl), which the SVBGA imports to sell to banana growers to control the banana borer, but which farmers are also increasingly applying on food crops. Villagers use the nematicides Furadan (carbofuran) and Mocap (ethoprop) mostly in banana cultivation. Basudin (diazinon) and Sevin (carbaryl) are the most frequently used agrochemicals applied exclusively on non-banana crops.

Whereas pesticide use in banana cultivation is widespread, it is more variable in food crop production (Table III). Villagers in Restin Hill do not apply pesticides on root and tuber crops and very infrequently on some

Table III. Pesticide Use on Selected Food Crops, Restin Hill Sample

Food crop	Number (%) of sample households[a] growing crop within previous 12 months[b]	Number (%) of sample households growing crop that applied at least one pesticide on it
Dasheen	36 (97)	0 (0)
Tomatoes	29 (78)	27 (93)
Cabbage	26 (70)	25 (96)
Beans	26 (70)	3 (12)
Cucumber	26 (70)	8 (31)
Carrots	19 (51)	12 (63)
Sweet potato	16 (43)	0 (0)

[a] $n = 37$.
[b] = July–August 1988 to July–August 1989.

other crops, such as beans, because pests rarely affect their marketability.[11] Only 31% of those growing cucumbers reported using pesticides on the crop. In contrast, almost all farmers apply pesticides on the two most economically important garden vegetables, tomatoes and cabbage.

CAUTION AND VARIABILITY IN PESTICIDE USE

One of the key issues in this study is the extent to which small-scale farmers, such as those in Restin Hill, use pesticides carelessly and indiscriminately. Field observations and interviews reveal that, although problems exist (Grossman, 1992), farmers are generally more cautious in their use of agrochemicals than would be expected from reading some of the literature on Third World pesticide use. Indeed, Restin Hill farmers refer to pesticides as "poisons," indicating their awareness of the possible dangers associated with chemical use in agriculture. Several practices reveal the extent of their caution.

The spatial organization of crops in their gardens is one indication. When planting food crops separately from bananas in steeply-sloping fields, farmers will grow their food crops on the top portion of the hill and the bananas on the lower portion. People fear that if bananas were planted on top of the hill and the food crops below, runoff during rainfall would carry pesticides used in banana production downhill to the food crops and contaminate them.

[11]In drier areas of the island, some farmers apply nematicides on sweet potatoes, but those in Restin Hill do not.

Another indication of caution is their refusal to follow recommendations by extension agents from both the SVBGA and the government. The SVBGA recommends that banana growers apply nematicides at the time of planting and then regularly at 4- to 6-month intervals, depending on the brand used. When villagers intercrop bananas with food crops, many do apply nematicides at the time of planting, but will not reapply them until 9 months later, after which they will have harvested almost all of their food crops; their rationale for delaying the second application is to prevent the nematicides from contaminating their food crops. Also, most banana farmers previously refused to use DBCP, the nematicide that WINBAN recommended in the 1960s and 1970s, because they feared that injecting the foul-smelling liquid into the soil would contaminate it and their food crops; such hesitancy was fortunate because subsequent research has revealed that DBCP, which is now banned for use in St. Vincent, can cause sterility in humans (Thrupp, 1988). Similar evidence of caution is available in relation to food crop cultivation. The large majority of farmers will not spray cabbage with pesticides after the leaves have folded (which occurs about 3 weeks before harvest) because they fear that later applications would leave unhealthy residues on the crop, even though government agricultural extension officers reassure them that Decis (deltamethrin) can be sprayed safely on cabbage up to 7 days before harvest.

Other evidence of concern about pesticide contamination exists. Some farmers who have cut bananas for home consumption (because the bunch will not pass SVBGA inspection as being suitable for export) will not leave them to ripen on the ground in their banana fields because they believe that pesticide residues on the ground would contaminate the ripening bunch.

Caution is also revealed when examining the age/sex distribution of pesticide users. Realizing that these chemicals can be harmful, parents do not allow their children to apply them. The youngest to use pesticides are 15-year-old males, who sometimes apply Gramoxone, though the task is usually reserved for older individuals. Because people believe that men in general are more resistant than women to the dangers from pesticides, women are much more hesitant to apply them than men are, and some women, especially pregnant women, refuse to use them at all. Data from the formal interview are illustrative of the predominance of male involvement in pesticide handling. Thirty-two of the 37 households in the sample contained both male and female adults (15 years and older); analysis of these households is relevant to the issue of female hesitancy to use pesticides because women can rely on men in their households to apply them. The pesticides that people fear most are the nematicides, especially the foul-smelling Mocap, because villagers associate the potential for harm with

Table IV. Female Use of Pesticides in Sample Households that Included Adult Males and Females, Restin Hill, 1989[a]

Pesticides	Number (%) of households applying the pesticides	Number (%) of these households in which women applied the pesticides
Nematicides	25 (78)	6 (24)
Gramoxone	31 (97)	13 (42)
Primicid	29 (91)	12 (41)
Sevin	17 (53)	12 (71)
Basudin	11 (34)	3 (27)

[a] $n = 32$.

strength of a pesticide's odor. Consequently, women prefer to let men (either their husbands, cohabiting male companions, or adult male children) apply them. In those households that applied nematicides, women did so in only 24% of the cases, whereas men used them in 88% (Table IV). For the other two widely used pesticides, Gramoxone and Primicid, which people fear less than the nematicides, women used them in only 42% and 41% of the households applying them, respectively. The figure for women using Gramoxone reflects, in addition to health concerns, the heavy weight of the knapsack sprayers (over 23 kg [50 lbs] when full) that people must carry to apply the herbicide. The highest percentage of female use of a pesticide is 71, which is for the insecticide Sevin, which people (correctly) believe is much less dangerous to them than most of the other pesticides used regularly.

Cautious use of pesticides also reflects, in part, economic considerations. They are expensive, and careless application would be economically wasteful. Such concern is evident in hiring agricultural wage laborers. Forty-six (17 out of 37) percent of the households in the sample had hired workers to assist in farming in the previous 12 months; of these, only five had hired laborers to apply pesticides, mainly for Gramoxone spraying. The limited hiring of workers for pesticide-related tasks reflects farmers' concerns about uncaring, careless workers possibly wasting expensive chemicals and possibly contaminating their food crops.

The evidence thus indicates that a certain degree of caution exists with regard to pesticide use; we clearly cannot generalize that Vincentian farmers are careless and indiscriminate. Nevertheless, pesticide misuse in Restin Hill does occur. Problems found elsewhere in the Third World are also evident here, such as failure to wear protective clothing, improper disposal of pesticide containers, and inappropriate selection of pesticides recommended for one crop for use on others (Grossman 1992). However, such misuse is not uniform among Restin Hill villagers. The key to understanding the issue of pesticide misuse lies in examining the extent and sig-

nificance of variability in pesticide-related practices and beliefs. For example, while many are cautious when applying pesticides, others are not. While some faithfully follow the instructions of SVBGA extension officers concerning proper chemical use, others do not. Some refuse to use any pesticides, as indicated by one woman who asserted, "They [pesticide users] may be gambling with their lives but I'm not gambling with mine"; in contrast, a few will apply them with their bare hands. Practices and attitudes in relation to pesticides are highly variable. The following examples from the results of the formal interviews explore the extent of variability further.

Patterns of pesticide application are one arena of variation, as the case of cabbage cultivation indicates. Twenty-six of the 37 respondents in the survey (70%) grew cabbage. Considerable diversity is evident in relation to nursery establishment, transplanting, and tending the growing plant. Twenty-three of the 26 indicated that they applied pesticides when setting seeds in their cabbage nurseries to control attacks by ants, but the choice of pesticide varied. Ten growers used Primicid, ten preferred Sevin, two relied on Furadan, and one used Mocap. At the next stage, transplanting from nursery to garden, the majority used Primicid but methods of application differed; seven farmers dipped just the roots of seedlings into Primicid, six completely immersed them in the pesticide solution, two sprayed the furrow before transplanting, and one sprayed the seedlings after transplanting. Four others applied Basudin and one put on Sevin. The general consensus was to apply pesticides after transplanting only when pest infestations occurred, but the choice of chemical varied—most preferred Basudin or Sevin, but others relied on Decis, Malathion, Furadan, or Primicid. Similar variability occurred in pesticide use on other crops such as tomatoes.

A second example of differences among farmers concerns beliefs about precautions necessary to prevent pesticides from damaging people's health. The majority believe that dietary patterns affect people's ability to resist damage from pesticides. Remarks such as, "If you are hungry, poison [pesticides] works through the body because you are empty," "Sugar water works out the poison," and "Resistance [to pesticides] is weak if you don't eat before" reflect local beliefs.

The specific nature and timing of the dietary precautions followed, however, varied. Fifteen farmers indicated that they ate a meal before applying pesticides, four combined a meal with drinking sugar-sweetened water beforehand, and eight preferred to consume a meal beforehand and drink sugar-sweetened water after using pesticides. The other responses included just drinking sugar-sweetened water, having some rum afterward, and not taking any dietary precautions. Although the biological efficacy of consuming such items is doubtful, the patterns are a further indication of individual variations.

The third example of variability concerns application of the herbicide Gramoxone, which farmers use primarily in banana cultivation but also in food crop production. Although the majority of users of the herbicide (64%) mixed Gramoxone only with water (which is environmentally the most sound practice), others sometimes added either kerosene or gasoline (or both) to the mixture. People used such additives either to provide a "sticking" agent (to help keep the sprayed Gramoxone attached to the plant leaf surface long enough to ensure desiccation) or to save money (the additives are less expensive than the herbicide). A few of those now using only Gramoxone had previously added these fuels but no longer do so because they either heard that the fuels could harm the soil or found them to be ineffective.

DISCUSSION

Much of the literature on Third World pesticide use emphasizes the influence of political–economic forces on the growth of pesticide use. The findings of this study support the broader literature in revealing the effects of political–economic forces in general and of commercial agriculture in particular on the expansion of agrochemical use in St. Vincent. The development model followed in St. Vincent has perpetuated its historic dependence on export agriculture, thus necessitating intensification of pesticide use over time in response to the changing market requirements of its former colonial ruler. Foreign aid, with its goal of maintaining the viability of export agriculture, has been an effective mechanism in stimulating agrochemical dependence. The pressures in marketing local food crops have also been significant in influencing growing pesticide use. Vincentian farmers have had to respond to the increasingly selective demands of urban consumers within St. Vincent by using more pesticides on their food crops.

Although a focus on political–economic influences is crucial in understanding growing dependence on agrochemicals, it has not illuminated some of the key patterns and processes at the local level that can exacerbate or limit potential problems accompanying increasing pesticide use. Political–economic studies tend to focus on broad-scale, structural forces influencing pesticide use, not on patterns of variability in perceptions and behavior at the local level. However, studies at the local level that do consider perception and behavior related to pesticides generally fail to examine adequately the dimensions of both caution and carelessness; when the subject is considered, the tendency is to emphasize careless and indiscriminate use. This study indicates, to the contrary, that many Vincentian farmers

are much more cautious and conscientious when using pesticides than the literature suggests. Additional detailed studies of village-level, pesticide-related behavior will likely further reveal the extent to which cautious behavior coexists with pesticide misuse. For example, in one of the few long-term studies of village pesticide use, Goldman (1986) describes how Kenyan farmers avoided using pesticides they feared would harm them and contaminate their crops and they applied less pesticides than agricultural officials recommended.

The coexistence of varying degrees of caution and carelessness is just one aspect of the general pattern of variability evident in beliefs and practices in the same community. Understanding such diversity is essential in uncovering dynamic processes that contribute to pesticide misuse. In particular, Johnson's (1972) analysis of individuality and experimentation as sources of innovation and change in traditional agriculture is highly relevant to understanding contemporary pesticide-related patterns of diversity and misuse.

In the contemporary scene, individuality and experimentation also generate variability in pesticide-related behavior and attitudes in both local food crop production and banana production. Farmers experiment with pesticides to solve their problems and improve their yields. One example of experimentation that generates variability is the formulation of "pesticide cocktails," that is, the combination of more than one pesticide in applications. Farmers devise such combinations on their own initiative, a practice based not on official recommendations but on their own experimentation. For example, Collymore (1984) revealed that cultivators in the northern part of St. Vincent devised a variety of pesticide combinations to control the depredations of rats. I found evidence for the practice in Restin Hill: one farmer used both Primicid and Basudin in the same application to control insect pests; villagers create another cocktail by combining kerosene or gasoline with Gramoxone for weed control. The application of such pesticide cocktails occurs elsewhere in the Caribbean (Pollard, 1981) as well as in other parts of the Third World (Fagoonee, 1987; Medina, 1987).[12] Another example of experimentation is the varying dosages formulated in applying Gramoxone. Although the majority of farmers used correct dosages, some used much stronger concentrations than recommended, claiming they obtained more effective weed control.[13] Individuality is evident in

[12]Such cocktails may be ineffective, wasteful, and in some cases hazardous to human health and the environment.

[13]Farmers increase concentrations of Gramoxone when recommended dosages fail to provide the desired weed control, a problem likely resulting from uneven spraying or the invasion of Gramoxone-resistant weeds into gardens. Using higher than recommended dosages of Gramoxone occurs elsewhere in the Caribbean (Rainey, 1985).

the wide range of practices associated with the application of nematicides in banana production, from some refusing to use them at all to a few others applying them with their bare hands; such practices reflect attitudes ranging from intense fear of pesticides to limited concern.

Although individuality and experimentation are characteristic of rural communities, the significance of these patterns for pesticide use can vary in different settings. Clearly, in some cases in the Third World, peasants have limited autonomy in decision-making with regard to pesticides, as can happen with tightly regulated contract-farming schemes; pressures to follow regimented pest-control practices may constrain, though not eliminate, variability generated by individuality and experimentation. However, in other situations, such as the Vincentian case, farmers have greater autonomy in decision-making concerning agrochemical use. In such cases, individuality and experimentation will produce considerable diversity in pesticide-use practices.

When pesticide misuse occurs, we cannot explain the exact nature of the problem by considering only political–economic forces, though their influence will be considerable. Similarly, at the individual level, we cannot simply attribute the problem to "ignorance" or "lack of knowledge," though lack of knowledge may contribute to some problems (e.g., Goldberg, 1985; Medina, 1987). Rather, problems of misuse also stem from the dynamic qualities of individuality and experimentation. Even when Restin Hill farmers are clearly aware of official recommendations concerning pesticide use, they often devise their own strategies. In essence, these farmers make decisions regarding agrochemicals based not on ignorance but on their combined consideration of official recommendations, their own experiments, advice from other farmers, and their own preferences and assessments of risks.

Certainly, economic factors, such as income and control over land, are likely to explain some variability in pesticide use among farmers. Although I was not able to collect data on incomes or areas cultivated for all 37 households in the sample, it is possible that these economic variables influenced some patterns, such as the number of pesticides used or amounts of money spent on pesticides. Similarly, low incomes can influence pesticide problems when some farmers are too poor to purchase protective equipment. However, most of the variability described in this paper is independent of such economic variables and is reflective of individuality and experimentation.

Individuality and experimentation, by leading to a variety of forms of pesticide use, tend to produce problems of misuse. Consequently, farmers use pesticides in numerous situations unintended by the officials importing them. The case of Primicid, imported by the SVBGA, is a prime example.

The SVBGA and the Ministry of Agriculture recommend that Primicid be used only for banana cultivation (to control the banana borer). However, villagers also apply it on their food crops. They use it at the time of setting cabbage and tomato seeds, at transplanting (usually dipping either the roots or entire seedlings in the liquid) to control the ever-hungry mole cricket (*Orthoptera gryllidae*), and less frequently after transplanting. Not only is Primicid supposed to be used only in banana cultivation, but it is also supposed to be applied only on the soil and not directly on plants. Farmers, however, do not use the same strength solution of Primicid in food crop production as they do in banana cultivation, believing that such a strong mixture would contaminate their food crops and inhibit plant growth. Instead, they use much weaker solutions, which they determine by the color of the liquid mixture, by measurement, or by smell (Several say they mix just enough Primicid to "catch the scent"). Thus, not only have they devised uses for Primicid unintended by the SVBGA, but they also have devised their own dosages. The ultimate impacts of such actions are unknown; although Primicid can leave residues on crops, the extent of the residue problem in St. Vincent is unknown because the manufacturer's original testing of the product was based on recommended solutions, not diluted ones. Another possible problem is that regular use of such diluted mixtures may actually facilitate pests developing resistance to Primicid. Similarly, a few farmers apply Furadan inappropriately in cabbage cultivation. The SVBGA imports Furadan to enable farmers to control nematodes in bananas. However, use of Furadan on crops such as cabbage may be hazardous because the active ingredient in Furadan (carbofuran) can be translocated and stored in leafy green matter, which people eat. The pattern of pesticides imported for use on one crop being subsequently applied inappropriately on others can be found elsewhere in the Caribbean (Pollard, 1981; Rainey, 1985).

Because experimentation and individuality combine to produce variations in pesticide-use patterns, it is highly likely that some of these variations will be safe for people and the environment while others will be harmful. The problem for farmers is the difficulty in evaluating the comprehensive, complex impacts of agrochemical use. Although they can assess the immediate, short-term effects on controlling pests on particular crops, analysis in relation to longer-term health and environmental impacts is much more difficult. Whereas in traditional agriculture farmers could readily evaluate the results of experimenting with new crop varieties or cultivation techniques, in contemporary agriculture their understanding of the implications of their diverse pesticide-use practices for such environmental processes as resistance to pesticides or biological magnification becomes much more problematic. Similarly, assessing pesticide impacts on human

health is difficult because many of the symptoms of low-level pesticide poisoning, such as headaches, nausea, and dizziness, can be attributed to a wide range of illnesses. In essence, the generation of variability that was an adaptive source of innovations in traditional agriculture can now prove maladaptive in the current context of pesticide use.

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